10/009,050

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
FP-4039.002		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US00/17280	23 June 2000 (23.06.2000)	25 June 1999 (25.06.1999)
International Patent Classification (IPC) or national classification and IPC		
IPC(7): A61H 7/00 and US Cl.: 601/148, 149, 150, 152		
Applicant		
MCCORD WINN TEXTRON INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   ☑ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 22 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
24 January 2001 (24.01.2001)	10 March 2002 (10.03.2002)
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Benjamin Kee Telephone No. 703-308-0858

Form PCT/IPEA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US00/17280

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed.

☒ the description:
pages 1, 7-11, 13-17 as originally filed
pages NONE, filed with the demand
pages 2-6, 12, 18, 18a-18g, filed with the letter of 11 February 2002 (11.02.2002)

☒ the claims:
pages NONE, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages 19-27, filed with the letter of 11 February 2002 (11.02.2002)

☒ the drawings:
pages 1-3, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages NONE

☐ the claims, Nos. NONE

☐ the drawings, sheets/~~fig~~ NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US00/17280

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Claims 1-24	YES
	Claims NONE	NO
Inventive Step (IS)	Claims NONE	YES
	Claims 1-24	NO
Industrial Applicability (IA)	Claims 1-24	YES
	Claims NONE	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-20 and 24 lack an inventive step under PCT Article 33(3) as being obvious over Fujimoto et al '772. Fujimoto shows a massage method comprising the steps of: providing a body support system (Fig. 2) including more than one expandable chamber (18), a pressure/exhaust system (Fig. 5), a control/switching mechanism to select different indexes (Fig. 4) for sequential control over various zones and varying intensities (Fig. 7-9), supply/exhaust valves & common exhaust providing inflow and outflow (60), a pump/pressure system (91), a pressure sensor (80), microcontroller (101), a series of zones (25, 18a-18g). Limitations regarding various alternatives in operation are all considered obvious design choices, well within the knowledge of a skilled artisan to suit various need and applications, all the variations being perfectly capable of being accomplished given the inherent structural features that have been demonstrated in the art.

Claims 21-23 lack an inventive step under PCT Article 33(3) as being obvious over Fujimoto in view of Cone et al '164. Fujimoto shows all the structural and functional limitations of the invention as set forth in the previous paragraphs of this office action except for the separate exhaust valves. Cone shows the use of exhaust valves (134) in a similar pneumatic device. It would have been obvious to use discrete exhaust valves because they are old and well know obvious art-recognized alternative exhausts, absent any unexpected results.

---------- NEW CITATIONS ----------US 5,611,772 A (Fujimoto et al) 18 March 1997, see entire document.US 5,591,200 A (Cone et al) 07 January 1997, see Fig. 6.

flow between each of the cells increases the time required for a full massage sequence.

In the '131 and '933 patents a massage control is provided to produce a pressure change at a given body part. There is no mention how a massage index might be utilized to produce a concentrated massage at more than one expandable chamber. The '131, furthermore, requires a range of movement in a single cell to cause the spine of the user to be moved or manipulated. Such action is more extreme than required for massage action.

While suitable for their intended purpose, the various known occupant support or vehicle seat systems with inflatable expandable chambers for contour shaping of a support such as on a vehicle seat surface do not provide for indexed expandable chamber pressure control. Furthermore, such systems do not disclose a support system having more than one expandable chamber operated to provide massage movement that includes a sequence of inflate and deflate of each of the respective chambers or cells so as to provide concentrated massage action while eliminating the problem of long massage cycle times as found in the '282 patent.

SUMMARY OF THE INVENTION

According to the invention a seat or body support apparatus is provided that comprises more than one expandable chamber, a pressure system and an exhaust system. The pressure system is connected to each expandable chamber and is configured to provide fluid into the expandable chambers. The exhaust system is connected to each expandable chamber and is configured to produce an outflow of fluid from the expandable chambers. A controller is connected to the pressure and exhaust systems and is configured to control massage sequence and intensity. The controller is configured to control massage sequence by alternately operating the pressure and exhaust systems for selected chambers according to a predetermined massage control index sequence. The controller is configured to control massage intensity by allowing fluid pressure

within the selected chambers to increase only until a selected variable target pressure is reached.

According to another aspect of the invention, a massage method is provided that includes providing a seat or body support system that includes more than one expandable chamber and also includes a pressure system and an exhaust system for each expandable chamber. A controller is provided for operating the pressure and exhaust systems according to multiple selectable predetermined massage control index sequences. A massage sequence is selected by selecting one of the massage control index sequences causing the controller to alternately, provide fluid communication between selected ones of the expandable chambers and the pressure system to produce an inflow of a fluid to each of the expandable chambers, and produce an outflow of fluid from each of the previously inflated expandable chambers by operating the exhaust system. Massage intensity is selected by allowing fluid pressure within the selected chambers to increase only until a selected variable target pressure is reached.

ADVANTAGES AND FEATURES OF THE VARIOUS ASPECTS OF THE INVENTION

The invention provides a fluidly (in some cases pneumatically) controlled support surface for an occupant such as in a seating system or bed having an array of expandable chambers or cells. Each of such expandable chambers is connected to a source of pressurized fluid (air), and arranged in a manner to inflate in response to produce a massage movement that includes a sequence of inflate and deflate at each of the respective cells in accordance with a massage index for concentrating the massage action on an occupant.

The invention also provides a massage method for an occupant support surface wherein one or more of the expandable chambers or cells is connected through an exhaust valve that will be opened in accordance with a control signal to produce a massage movement including a separate deflate at each of the respective cells so as to provide more concentrated massage.

According to another aspect of the invention more than one expandable chamber provide an indexed massage in accordance with user selected massage types and preprogrammed inflation and deflation of individual expandable chambers by inflate and deflate steps including flow to and from each of a series of individual expandable chambers so as to produce a concentrated pulse type massage action.

According to another aspect or feature of the invention such a pulse type massage action is provided by inflating each of the individual expandable chambers in a progression and thereafter deflating each of the individual expandable chambers by reversing the progression.

Another feature of the present invention is to provide a control sequence for the concentrated massage action is under microcomputer control.

A still further feature is to include the expandable chambers as a seat back and seat bottom support including such occupant massage.

Another feature of the present invention is to provide a control system in the supporting surface of an occupant support including a microcomputer that is programmed to operate a manifold/valve system to automatically fill and deflate individual expandable chambers by fluid flow to and from each expandable chamber in a serial fashion so as to so as to provide more concentrated massage.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems in which the controller is programmed to operate multiple valves and a pump to conduct an initial inflate or inflation of the expandable chambers or cells to a gross pressure level with all of the valves initially open followed by continuous pressure reads and a sequential closure of each pressure zone formed by one or more cells as the pressure therein is compared by operation of the microcomputer to a desired target pressure and to provide a secondary adjustment of the desired target pressure.

Another feature of the present invention is to provide micro-computer control of the preceding feature wherein the sequential control of the fluid volume flow to and from each expandable chamber or cell is either by a pressure pump inflation with open supply valves inflation or by an exhaust valve deflation.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems that conditions the system to open all the cells to atmosphere when a seat is not occupied and to inflate the seat back to a desired initialization pressure for occupant support.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems in which an initial occupant assessment is made and inputted to the microcomputer and used to establish a selected massage index in a look-up table for use in a massage control operation of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an automotive seat showing one embodiment of the invention for locating pneumatic massage expandable chambers or in the back, seat and head rest positions of a vehicle seat structure.

Figure 2 is a view of a pressure supply system for the embodiment of Figure 1;

Figure 3 is a view of a programmable massage operating system for the embodiment of Figure 1;

Figure 4 is a view of another embodiment of a massage system for use with the method of the present invention; and

Figure 5 is a view of still another embodiment of a massage system for use with the method of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A series of expandable chambers or bladder like air cells 1 are placed at strategic locations about the contour of an automotive seat 2 as shown in Figure 1. The expandable chamber or cell placement is selected to coincide with key pressure points on the body of an occupant of the seat.

In particular, a plurality of expandable chambers or cells 3a, 3b, 3c are positioned in the thoracic region while plural cells 4a, 4b, 4c are combined in the lumbar region. To further facilitate the adjustment of the seat, pairs of cells 5, 6, 7 and 8 are positioned at either side of the back and seat as well as the front and back of the thighs respectively. Each of these cells is in direct contact with the body to

The massage indexes of the present invention will be understood to have application to either the embodiment of Figure 2 or the embodiments shown in Figure 6 and in Figure 7 of previously mentioned USSN 8/808,511. The massage indexes also applies to the embodiments of Figures 4 and 5. It should be understood that the operation of the inflate, deflate and if desired equilibrate indexes to be described herein apply equally well to systems in which the expandable chambers or cells can be independently positioned or remain in a predetermined position on a support surface of a vehicle seat or the like without being part of a pressure system for supporting an occupant.

The device and method of this invention is characterized by using a preset inflate, deflate and if desired an equilibration massage index sequence as the programmed massage level and type and allowing the system to adjust the pressure in each expandable chamber to produce a predetermined massage where the level and intensity of a massage can be selected ranging from light to high that can correspond to a lower pressure or a lower frequency at the light setting; a medium pressure or a medium frequency at the medium setting, etc. In addition the operator can adjust the pressure level in accordance with his or her own perceived massage comfort. It is observed that by varying the comparative massage data and the number and location of the expandable chambers the system of this invention allows for a wide variety of massage types and an almost infinite flexibility of adjustment in a package that is simple, light weight, low cost and efficient.

Additionally, in accordance with the present invention, expandable chambers or cells forming the contouring elements of the seat back and bottom can also be located to form a support in a bed structure or other occupant support system. In this case as in the vehicle seat application the expandable chambers have their pressure controlled in response to the selected type of massage index resulting in a sequence of flow to and from each expandable chamber during a predetermined inflate, deflate and if desired equilibrate sequence.

In the present invention, "inflate" is defined as an increase in volume or pressure of fluid (including but not limited to air) in one of one or more expandable

In each of these cases the expandable chambers do not carry the reference numeral designations shown in the various embodiments but it is understood that the designations are for a support system having zones 0, 1, 2 (could correspond to 4a, 4b, 4c) and zones 5, 6 and 7 (could correspond to 3a, 3b, 3c).

As set forth in the claims, a seat or body support apparatus constructed according to the invention is most broadly described as comprising more than one expandable chamber; a pressure system connected to each expandable chamber and configured to provide fluid into the expandable chambers; an exhaust system connected to each expandable chamber and configured to produce an outflow of fluid from the expandable chambers, and a controller connected to the pressure and exhaust systems. The controller is configured to control massage sequence by alternately operating the pressure and exhaust systems for selected chambers according to a predetermined massage control index sequence. The controller is also configured to control massage intensity by allowing fluid pressure within the selected chambers to increase only until a selected variable target pressure is reached.

The pressure system may include a source of pressurized fluid connected by fluid supply paths to respective supply valves positioned to selectively provide fluid communication between each expandable chamber and the source of pressurized fluid. The exhaust system may include exhaust valves connected to each respective chamber and configured to control the fluid flow from the respective chambers. The controller may then be operatively connected to the supply and exhaust valves and configured to inflate selected chambers by opening corresponding ones of the supply valves and to deflate selected chambers by opening corresponding ones of the exhaust valves. The exhaust valves are distinct from the supply valves and the fluid supply paths to minimize dwell time between inflation and deflation.

The exhaust system may be configured to actively evacuate chambers by drawing fluid from them. To accomplish this, the exhaust system may include an exhaust pump connected to the controller and operable to draw fluid from selected chambers.

The controller may be further configured to provide a range of different massage index sequences. The apparatus in this case includes a user actuable switch connected to the controller and configured to select between the different massage index sequences.

In practice, a massage may be provided by first providing a seat or body support system, such as the one described above, that includes more than one expandable chamber, a pressure system and an exhaust system for each expandable chamber, and a controller for operating the pressure and exhaust systems according to multiple selectable predetermined massage control index sequences. A massage sequence is then selected by selecting one of the massage control index sequences causing the controller to alternately provide fluid communication between selected ones of the expandable chambers and the pressure system to produce an inflow of a fluid to each of the expandable chambers and produce an outflow of fluid from each of the previously inflated expandable chambers by operating the exhaust system. Massage intensity is selected by allowing fluid pressure within the selected chambers to increase only until a selected variable target pressure is reached.

The step of providing a seat or body support system may include providing a pressure system that includes a source of pressurized fluid and a supply valve connected to the controller for controlling fluid flow from the pressure source to each of the expandable chambers, and providing an exhaust system that includes an exhaust valve connected to the controller for controlling the fluid flow from a previously inflated expandable chamber. The supply and exhaust valves may then be operated to produce individual chamber to chamber

inflation followed by chamber to chamber deflation.

The step of providing a seat or body support system may include providing an exhaust system that includes a common exhaust. In this case, operating the exhaust system includes providing fluid communication between the expandable chambers and the common exhaust; and opening the common exhaust in accordance with the massage index sequence.

The step of providing a seat or body support system may include providing a pressure system that includes a pressure pump and providing an exhaust system that includes an exhaust pump. In this case fluid communication is selectively and alternately provided between each expandable chamber and the pressure pump and the exhaust pump in accordance with the massage index sequence.

A user initiated switch may be provided along with a range of desired massage index sequences in accordance with user selected preferences. The switch is operated to select one of the desired massage index sequences from the range of sequences to produce individual chamber to chamber inflation followed by chamber to chamber deflation.

The step of providing a seat or body support system may include providing expandable chambers in a back and seat support.

The pressure system may be operated for each expandable chamber to equalize the pressure between predetermined ones of the expandable chambers as each of the predetermined ones of the expandable chambers are selectively inflated and deflated.

A pressure sensor, multiple valves and a pump may be provided along with a microcontroller programmed in response to a signal from the pressure sensor to operate the multiple valves and a pump to initially inflate the expandable chambers to a gross pressure level with all of the valves initially opening. The initial opening occurs prior to cyclically connecting each of the expandable chambers to the pressure source in accordance with the selected massage index sequence.

The step of providing a seat or body support system may include providing the expandable chambers as a series of zones. In this case, the step of selecting a massage sequence includes selecting a massage index sequence that first inflates each of the zones in a series fashion then deflates each of the zones in a reverse series fashion.

The step of providing a seat or body support system may also include providing the expandable chambers as a series of zones including a first zone, a second zone and a third zone. In this case, the step of selecting a massage sequence includes selecting a massage index sequence that equalizes the pressure in the first and second zones by fluid transfer therebetween, then inflates only the first zone and deflates the second zone while the first zone remains inflated, then equalizes the pressure in the first and second zones, then inflates the second zone, then deflates the first zone while the second zone remains inflated. The pressure is then equalized in the second and third zones by fluid transfer therebetween and then only

the third zone is inflated and the second zone is deflated while the third zone remains inflated.

The step of providing a seat or body support system may include providing first and second air cells (O, 1). In this case, the step of selecting a massage sequence includes providing and selecting a massage index sequence that cyclically varies the pressure in the air cells by inflating the first air cell, equalizing pressure between the first and second air cells, deflating the first air cell, reinflating the first air cell, controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell, and deflating the first air cell.

The step of providing a seat or body support system may include providing first and second air cells (O, 1). In this case, the step of selecting a massage sequence includes providing and selecting a massage index sequence that cyclically varies the pressure in the air cells by inflating the first air cell, equalizing pressure between the first and second air cells, deflating the first air cell, reinflating the first air cell; controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell; and deflating the first air cell.

The step of providing a seat or body support system may include providing expandable chambers as a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7. In this case, the step of selecting a massage sequence includes providing and selecting a massage index sequence that includes equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate

zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the pressure in zone 6 and increasing the pressure in zone 7); inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

The step of providing a seat or body support system may include providing expandable chambers including a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7. In this case the step of selecting a massage sequence includes providing and selecting a massage index sequence including equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the

pressure in zone 6 and increasing the pressure in zone 7); inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

The step of selecting massage intensity may include selecting a massage index sequence that achieves a selected variable target pressure within each selected chamber by scaling inflation time.

The step of providing a seat or body support system may include providing a pressure sensor in fluid communication with each chamber and connected to the controller. In this case, the step of selecting massage intensity includes selecting a massage index sequence that achieves a selected variable target pressure within each selected chamber by increasing fluid pressure in each chamber until the controller receives respective signals from the pressure sensors indicating that their respective target pressures have been reached.

The steps of selecting massage sequence and massage intensity may be accomplished simultaneously by selecting a single massage control index sequence.

The step of providing a seat or body support system may include providing an exhaust system configured to actively evacuate chambers by drawing fluid from them.

The step of providing a seat or body support system may include providing an exhaust system that includes an exhaust pump. In this case, operating the exhaust system includes providing fluid communication between selected chambers to be deflated and the exhaust pump and operating the pump to evacuate the selected chambers.

This is an illustrative description of invention embodiments using descriptive rather than limiting words. Many modifications and variations are possible within the scope of the claims and one may practice the invention other than as described.

What is claimed is:

1. A massage method comprising the steps of:

providing a seat or body support system including more than one expandable chamber and including a pressure system and an exhaust system for each expandable chamber;

providing a controller for operating the pressure and exhaust systems according to multiple selectable predetermined massage control index sequences;

selecting a massage sequence by selecting one of the massage control index sequences causing the controller to alternately:

provide fluid communication between selected ones of the expandable chambers and the pressure system to produce an inflow of a fluid to each of the expandable chambers; and

produce an outflow of fluid from each of the previously inflated expandable chambers by operating the exhaust system; and

selecting massage intensity by allowing fluid pressure within the selected chambers to increase only until a selected variable target pressure is reached.

2. The method of claim 1 in which the step of providing a seat or body support system includes:

providing a pressure system that includes a source of pressurized fluid and a supply valve connected to the controller for controlling fluid flow from the pressure source to each of the expandable chambers;

providing an exhaust system that includes an exhaust valve connected to the controller for controlling the fluid flow from a previously inflated expandable chamber; and

operating the supply and exhaust valves to produce individual chamber to chamber inflation followed by chamber to chamber deflation.

3. The method of claim 2 in which:

the step of providing a seat or body support system includes providing an exhaust system that includes a common exhaust ; and operating the exhaust system includes:

providing fluid communication between the expandable chambers and the common exhaust; and

opening the common exhaust in accordance with the massage index sequence.

4. The method of claim 2 in which:

the step of providing a seat or body support system includes:

providing a pressure system that includes a pressure pump; and

providing an exhaust system that includes an exhaust pump;

and including the additional step of selectively and alternately providing fluid communication between each expandable chamber and the pressure pump and the exhaust pump in accordance with the massage index sequence.

5. The method of claim 1 including the additional steps of:

providing a user initiated switch;

providing a range of desired massage index sequences in accordance with user selected preferences; and

operating the switch to select one of the desired massage index sequences from said range to produce individual chamber to chamber inflation followed by chamber to chamber deflation.

6. The method of claim 1 in which the step of providing a seat or body support system includes providing expandable chambers in a back and seat support.

7. The method of claim 1 including the additional step of operating the pressure system for each expandable chamber to equalize the pressure between predetermined ones of the expandable chambers as each of the predetermined ones of the expandable chambers are selectively inflated and deflated.

8. The method of claim 1 including the additional steps of:

providing a pressure sensor;

providing multiple valves and a pump;

providing a microcontroller programmed in response to a signal from said pressure sensor to operate the multiple valves and a pump to initially inflate the expandable chambers to a gross pressure level with all of the valves initially opening; the initial opening occurring prior to cyclically connecting each of the expandable chambers to the pressure source in accordance with the selected massage index sequence.

9. The method of claim 1 in which:

the step of providing a seat or body support system includes providing the expandable chambers as a series of zones; and

the step of selecting a massage sequence includes selecting a massage index sequence that first inflates each of the zones in a series fashion then deflates each of the zones in a reverse series fashion.

10. The method of claim 1 in which:

the step of providing a seat or body support system includes providing the expandable chambers as a series of zones including a first zone, a second zone and a third zone;

the step of selecting a massage sequence includes selecting a massage index sequence that:

equalizes the pressure in the first and second zones by fluid transfer therebetween;

thereafter inflates only the first zone and deflates the second zone while the first zone remains inflated;

thereafter equalizes the pressure in the first and second zones;

thereafter inflates the second zone;

thereafter deflates the first zone while the second zone remains inflated;

equalizing the pressure in the second and third zones by fluid transfer therebetween; and

thereafter inflating only the third zone and deflating the second zone while the third zone remains inflated.

11. The method of claim 1 in which:

the step of providing a seat or body support system includes providing first and second air cells (O, 1); and

the step of selecting a massage sequence includes providing and selecting a massage index sequence that cyclically varies the pressure in the air cells by:

inflating the first air cell;

equalizing pressure between the first and second air cells;

deflating the first air cell;

reinflating the first air cell;

controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell; and

deflating the first air cell.

12. The method of claim 2 in which:

the step of providing a seat or body support system includes providing first and second air cells (O, 1); and

the step of selecting a massage sequence includes providing and selecting a massage index sequence that cyclically varies the pressure in the air cells by:

inflating the first air cell;

equalizing pressure between the first and second air cells;

deflating the first air cell;

reinflating the first air cell; controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell; and

deflating the first air cell.

13. The method of claim 1 in which the step of providing a seat or body support system includes providing expandable chambers as a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7; and

the step of selecting a massage sequence includes providing and selecting a massage index sequence that includes equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the pressure in zone 6 and increasing the pressure in zone 7);

inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

14. The method of claim 2 in which the step of providing a seat or body support system includes providing expandable chambers including a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7; and

the step of selecting a massage sequence includes providing and selecting a massage index sequence including equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the pressure in zone 6 and increasing the pressure in zone 7); inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to

zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

15. The method of claim 1 in which the step of selecting massage intensity includes selecting a massage index sequence that achieves a selected variable target pressure within each selected chamber by scaling inflation time.

16. The method of claim 1 in which:

the step of providing a seat or body support system includes providing a pressure sensor in fluid communication with each chamber and connected to the controller; and

the step of selecting massage intensity includes selecting a massage index sequence that achieves a selected variable target pressure within each selected chamber by increasing fluid pressure in each chamber until the controller receives respective signals from the pressure sensors indicating that their respective target pressures have been reached.

17. The method of claim 1 in which the steps of selecting massage sequence and massage intensity are accomplished simultaneously by selecting a single massage control index sequence.

18. The method of claim 1 in which the step of providing a seat or body support system includes providing an exhaust system configured to actively evacuate chambers by drawing fluid from them.

19. The method of claim 18 in which:

the step of providing a seat or body support system includes providing an exhaust system that includes an exhaust pump; and

operating the exhaust system includes:

providing fluid communication between selected chambers to be deflated and the exhaust pump; and

operating the pump to evacuate the selected chambers.

20. A seat or body support apparatus comprising:

more than one expandable chamber;

a pressure system connected to each expandable chamber and configured to provide fluid into the expandable chambers;

an exhaust system connected to each expandable chamber and configured to produce an outflow of fluid from the expandable chambers;

a controller connected to the pressure and exhaust systems and configured to:

control massage sequence by alternately operating the pressure and exhaust systems for selected chambers according to a predetermined massage control index sequence; and

control massage intensity by allowing fluid pressure within the selected chambers to increase only until a selected variable target pressure is reached.

21. A seat or body support apparatus as set forth in claim 20 in which:

the pressure system includes a source of pressurized fluid connected by fluid supply paths to respective supply valves positioned to selectively provide fluid communication between each expandable chamber and the source of pressurized fluid;

the exhaust system includes exhaust valves connected to each respective chamber and configured to control the fluid flow from the respective chambers;

the controller is operatively connected to the supply and exhaust valves and is configured to inflate selected chambers by opening corresponding ones of the supply valves and to deflate selected chambers by opening corresponding ones of the exhaust valves; and

the exhaust valves are distinct from the supply valves and the fluid supply

paths to minimize dwell time between inflation and deflation.

22. A seat or body support apparatus as set forth in claim 20 in which the exhaust system is configured to actively evacuate chambers by drawing fluid from them.

23. A seat or body support apparatus as set forth in claim 22 in which the exhaust system includes an exhaust pump connected to the controller and operable to draw fluid from selected chambers.

24. A seat or body support apparatus as set forth in claim 20 in which:

the controller is further configured to provide a range of different massage index sequences; and

the apparatus includes a user actuable switch connected to the controller and configured to select between the different massage index sequences.

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(54) Title: MULTIPLE BLADDER PARTIAL BODY OR FULL BODY SUPPORT MASSAGE SYSTEM INCLUDING A METHOD OF CONTROL

(57) Abstract: A method for controlling a fluidly (in some cases pneumatically) controlled support surface for an occupant system or bed having an array of expandable chambers or cell includes providing such expandable chambers; connecting to a source of pressurized fluid (air), and inflating to produce a massage movement that includes a sequence of inflate and deflate at each of the respective cells in accordance with a massage index for concentrating the massage action on an occupant.

MULTIPLE BLADDER PARTIAL BODY OR FULL BODY SUPPORT MASSAGE SYSTEM INCLUDING A METHOD OF CONTROL

FIELD OF THE INVENTION

This invention relates to vehicle or chair seating or bed support configurations comprised of inflatable expandable chambers or air cells for controlling the contour of the supporting inflatable cells to produce selective body or full body massage.

BACKGROUND OF THE INVENTION

Inflatable expandable chambers or air cells have been used in a variety of configurations to provide adjustments to the pressure in the inflatable air cells so as to produce a massage action on an occupant supported on the inflatable expandable chambers or air cells. This is especially important in automobiles where long periods of driving can cause pain and distraction or in other seating applications where individuals are sedentary for long periods of time.

Prior art seating systems including body massage are set-forth in USPNs 4,655,505; 4,981,131; 5,135,282; 5,587,933 wherein inflatable expandable chambers or air cells are provided to adjust the pressure to produce a massage action on an occupant of a support surface. In the '505 patent the only type of massage mentioned incorporates changes in the support pressure.

In the '282 patent a sequential control of the pressure in expandable chambers or cells pressure includes a sequential pressurization of each of the chambers or cells forming the back support for a supporting surface.

The expandable chambers are interconnected by valves that are responsive to pressure in the expandable chambers to cause one after another of the cells to be inflated and then deflated. The result is a broad wave front type of massage that requires transfer of pressure through all of the cells rather than flow of fluid to and from each cell. The requirement that pressure responsive valves direct

flow between each of the cells increases the time required for a full massage sequence.

In the '131 and '933 patents a massage control is provided to produce a pressure change at a given body part. There is no mention how a massage index might be utilized to produce a concentrated massage at more than one expandable chamber. The '131, furthermore, requires a range of movement in a single cell to cause the spine of the user to be moved or manipulated. Such action is more extreme than required for massage action.

While suitable for their intended purpose, the various known occupant support or vehicle seat systems with inflatable expandable chambers for contour shaping of a support such as on a vehicle seat surface do not provide for indexed expandable chamber pressure control. Furthermore, such systems do not disclose a support system having more than one expandable chamber operated to provide massage movement that includes a sequence of inflate and deflate of each of the respective chambers or cells so as to provide concentrated massage action while eliminating the problem of long massage cycle times as found in the '282 patent.

SUMMARY OF THE INVENTION

A system of inflatable expandable chambers or air cells is constructed and installed in a seat or other like occupant support at locations which are strategic to the comfort of the user. The expandable chambers or air cells are connected to a pressure system including a pressure source such as a pump. The pump supplies pressurized fluid to a manifold and valve arrangement which simultaneously or sequentially, as desired, connects each cell to the pump to inflate each cell. The flow of fluid into and out of each of the expandable chambers is controlled by means of a system of supply valves and one or more exhaust or vent valves to produce massage movement that includes a sequence of inflate and deflate of each of the respective expandable chambers or cells so as to provide more concentrated massage.

Specifically, the massage of the present invention includes an inflate; a deflate and possibly an equalization of pressure between two cells (equilibration).

In the present invention inflate is defined as an increase in volume or pressure of fluid (including but not limited to air) in one of one or more expandable chambers. Such increase in volume or pressure is effected by opening a supply valve and closing a vent valve while energizing the pump(s) to move volumes of fluid either for a time or until a specified pressure is achieved. In most cases, the pump is connected to a manifold or common chamber and a supply valve is connected to each of the expandable chambers to control the flow of fluid the between the common manifold chamber and the other one or more expandable chambers.

Deflate in the present invention is defined as decreasing the volume or pressure of fluid (a fluid may include air but is not limited to air as the fluid medium) in one of the expandable chambers. Such deflation is effected, in one configuration, by closing a supply valve to the chamber and opening a vent valve to move volumes of fluid either for a time or until a particular pressure is achieved. Such deflation is effected, in another configuration, by opening the vent valve (controls the flow of fluid from the common chamber to the atmosphere) and the supply valve to the particular chamber (controls the flow of fluid between the common chamber and the other chambers).

Equilibrate is defined in the present invention as an exchange of fluid (including but not limited to air) between two or more of one or more expandable chambers. Such exchange of fluid is effected by closing the vent valve(s) of two or more chambers and opening supply valves to the same two or more chambers for a specified time. The fluid will flow from the higher-pressure chamber(s) to the lower pressure chamber(s) resulting in an equalization of pressure in all of the participating chambers. The resultant pressure will be less than the initial higher pressures and more than the initial lower pressures unless the pressures were equal to start with.

In one controller suitable for use in the present invention, a microcomputer's non-volatile memory is programmed with data representing a

desired massage type and level for the expandable chambers or cells. By sequentially activating individual supply valves, a pressure signal from a transducer can be generated for each cell. The pressure signals are received by the microcomputer and can be compared with the predetermined massage level data to generate a control signal which activates the pump or open and close the supply and exhaust valves. Additionally, in accordance with the present invention, expandable chambers forming the contouring elements of the seat back and seat bottom can have their pressure controlled by a timer to control the activation of the pump or opening and closing of the supply and exhaust valves to produce the desired massage affect.

One purpose of this invention is to provide a fluidly (in some cases pneumatically) controlled support surface for an occupant such as in a seating system or bed having an array of expandable chambers or cells. Each of such expandable chambers is connected to a source of pressurized fluid (air), and arranged in a manner to inflate in response to produce a massage movement that includes a sequence of inflate and deflate at each of the respective cells in accordance with a massage index for concentrating the massage action on an occupant.

An object of the invention is to provide a massage method for a occupant support surface wherein one or more of the expandable chambers or cells is connected through an exhaust valve that will be opened in accordance with a control signal to produce a massage movement including a separate deflate at each of the respective cells so as to provide more concentrated massage.

Furthermore, another object is to provide more than one expandable chamber that will provide an indexed massage in accordance with user selected massage types and preprogrammed inflation and deflation of individual expandable chambers by inflate and deflate steps including flow to and from each of a series of individual expandable chambers so as to produce a concentrated pulse type massage action.

A further object is to provide such a pulse type massage action by inflating each of the individual expandable chambers in a progression and thereafter

deflating each of the individual expandable chambers by reversing the progression.

One feature of the present invention is to provide the system of the preceding objects wherein the control sequence for the concentrated massage action is under a microcomputer control.

A still further feature is to include the expandable chambers as a seat back and seat bottom support including such occupant massage.

Another feature of the present invention is to provide a control system for such massage in the supporting surface of a occupant support including a microcomputer that is programmed to operate a manifold/valve system to automatically fill and deflate individual expandable chambers by fluid flow to and from each expandable chamber in a serial fashion so as to so as to provide more concentrated massage.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems in which the controller is programmed to operate multiple valves and a pump to conduct an initial inflate of the expandable chambers or cells to a gross pressure level with all of the valves initially open followed by continuous pressure reads and a sequential closure of each pressure zone formed by one or more cells as the pressure therein is compared by operation of the microcomputer to a desired target pressure and to provide a secondary adjustment of the desired target pressure.

A further object of the present invention is to provide a microcomputer control of the preceding object wherein the sequential control of the fluid volume flow to and from each expandable chamber or cell is either by a pressure pump inflation with open supply valves inflation or by an exhaust valve deflation.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems that conditions the system to open all the cells to atmosphere when a seat is not occupied and to inflate the seat back to a desired initialization pressure for occupant support.

Still another feature of the present invention is to provide a microcomputer in the aforesaid systems in which an initial occupant assessment is made and inputted to the microcomputer and utilized to establish a selected massage index in

a look-up table for use in a massage control operation of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an automotive seat showing one embodiment of the invention for locating pneumatic massage expandable chambers or in the back, seat and head rest positions of a vehicle seat structure.

Figure 2 is a view of a pressure supply system for the embodiment of Figure 1;

Figure 3 is a view of a programmable massage operating system for the embodiment of Figure 1;

Figure 4 is a view of another embodiment of a massage system for use with the method of the present invention; and

Figure 5 is a view of still another embodiment of a massage system for use with the method of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A series of expandable chambers or bladder like air cells 1 are placed at strategic locations about the contour of an automotive seat 2 as shown in Figure 1. The expandable chamber or cell placement is selected to coincide with key pressure points on the body of an occupant of the seat.

In particular, a plurality of expandable chambers or cells 3a, 3b, 3c are positioned in the thoracic region while plural cells 4a, 4b, 4c are combined in the lumbar region. To further facilitate the adjustment of the seat, pairs of cells 5, 6, 7 and 8 are positioned at either side of the back and seat as well as the front and back of the thighs respectively. Each of these cells is in direct contact with the body to

provide the control system with information which may be related to the comfort of the user and in accordance with this invention to provide a desired massage action.

In addition to the pairs of cells that are provided to adjust the comfort of a user, in accordance with the present invention a plurality of expandable chambers 9 are formed in the head rest and a plurality of expandable chambers 10a, 10b, 10c are provided in the seat bottom.

The cells are connected to a pressure system including a source of pressurized fluid provided in part by a pump 12 through a manifold 14 as shown in Figure 2. The manifold 14 and pump 12 are controlled by a controller 16 responsive to pressure signal from a transducer 18. Alternatively, instantaneous data may be sensed by an array of force sensors as described in U.S. Patent No. 5,283,735 in the place of the transducer 18. In the latter instance the sequencing would remain the same, but it would be coordinated with a polling of the sensor array.

Each individual expandable chamber or cell is constructed of a suitable flexible material such as rubber, thermoplastic polyurethane coated fabric or any other material provided with a fluid tight connection to the manifold to provide a path for conducting fluid into and out of the cell. The cells may be connected individually to the manifold or jointly with other cells. Individual spaced parallel cells 3a-3c, 4a-4c, and 10a-10c, located for full body support and for full body massage if desired, are each connected to a single supply valve 26 controlled in a manner to provide a concentrated pulse or wave action massage to be described. The invention also contemplates use of a pressurizable mat in place thereof that includes segments that are pressure controlled to produce the massage action of the present invention.

The manifold 14 consists of a housing 20 enclosing a common chamber 22 constructed with multiple outlet ports 24 for connecting the common chamber 22 to the inlet/outlet tubes of each individual cell or regional group of cells. Each outlet port 24 is provided with an outlet or supply valve 26 to each expandable chamber (or group of expandable chambers if interconnected) for controlling the flow of fluid to and from each of the expandable chambers or cells. In this embodiment,

the sensor is a pressure sensing transducer 18 that is operatively connected in the manifold to sense the pressure in the common chamber 22 and generate a signal indicative thereof. Chamber 22 is also constructed with a single inlet port 28 which is connected to a feed tube 30 to receive pressurized fluid, in this case air, from pump 12. A supply valve 32 is provided in feed tube 30 to control the flow of pressurized fluid to the manifold. The manifold can be molded of a high strength plastic material or other suitable material. The plastic material arrangement can have many of its components integrally molded therein. It is preferred that it be as compact and lightweight as possible. However, the invention can be configured with other than lightweight components and other than with integral components. A common exhaust valve 34 is provided to selectively release pressure from the common manifold chamber 22 through venting port 36. The pressure in common chamber 22 can therefore be adjusted by either actuating pump 12 or exhaust valve 34.

In the embodiment of Figure 4, a pressure system is shown somewhat diagrammatically as including a controller 16' and a common manifold chamber 22' that is connected to a pressure source shown as a pump 12'. The controller 16' includes a valve drive 35' and a pump drive 12b' like those shown in Figure 3. The pressure system includes a supply valve 26' to each of the expandable chambers or air cells 3', 4', 10' with it being understood that the chambers 3', 4' and 10' can include three separate chambers as in the first embodiment. In this embodiment, exhaust is provided by a second pump 12a' connected to a second common manifold chamber 22a'. An exhaust valve 34' is connected to each of the expandable chambers and to the second common manifold chamber 22a'. In this embodiment, the inflate of each cell is the same as in the first embodiment. The deflate is produced when a valve 26' is closed to one of the expandable chambers when the exhaust valve 34' connected to the one of the expandable chambers is opened and the pump 12a' is energized to produce a rapid movement of fluid from the expandable chamber that is being exhausted. Such inflow and outflow patterns produces a direct and concentrated inflate and deflate at each of the respective expandable chambers in accordance with massage indexes to be described.

In the embodiment in Figure 5 a pressure system is shown somewhat diagrammatically in which a supply pump 12", valve drive 35" and pump drive 12b" like those in Figure 3 are connected during inflate through a common chamber or conduit 22" thence through supply valves 26" to each one of more than one expandable chambers 3", 4" and 5" with it being understood that the chambers 3", 4" and 10" can include three separate chambers as in the other embodiments. Deflate is produced when exhaust valves 34" are opened and valves 26" are closed so as to connect individual ones of the expandable chambers to a common exhaust conduit 22a" that is connected in turn to an exhaust pump 12a". In this embodiment the exhaust valves 34" are connected to a conduit 27" for fluid flow both to and from each of the expandable chambers.

Supply valves 26, 26', 26" and exhaust valves 34, 34', 34" are actuated by an electrical signal from a valve drive 35, 35', 35" and are designed for low power, low fluid resistant operation. More specifically each valve 26, 26', 26", 34, 34', 34", is an adaptation of highly efficient valves used in medical applications such as MEMS type or piezoelectric actuated valves. The bodies and valve seats of such designs are easily moldable with and can be integrated as lightweight components within the manifold body. Individual valve bodies can be designed for stacking assembly to form the manifold of this invention. In addition to a piezoelectric actuated valve other low energy actuated valves are contemplated by the present invention including but not limited to electrically pulsed reed valves; valves having an actuator configured of nickel titanium alloy such as Nitinol; magnetic inductive type valves or fluidic control valves so long as low energy consumption will operate the valve in on-off positions in which the flow from an inlet to outlet will satisfy the flow requirements of the pressure adjusted expandable chambers or in a given electropneumatic system for controlling a seating surface such as a seat, chair or bed to provide contouring, movement, support and/or comfort at a user interface. The importance of the use of such a valve arrangement in the present invention is that, in the past, pressure adjusted systems have utilized solenoid actuated valves to open and close an expandable chamber or to a pressure source for inflating the expandable chamber or to a relief path for deflating the expandable chamber or. In

such applications, the size of the control package is difficult to contain within the confines of a vehicle seat structure. Furthermore, power consumption is a problem since the major power consumers in the system combine power flow for operation of a motor driven pump and the power flow for operating the solenoids connected to the mechanical valving components. However, if desired, the supply valves 26, 26', 26" and exhaust valves 34, 34', 34" can be solenoid operated valves.

The active parts of the systems of this invention namely, the transducer 18, pumps 12, 12', 12", 12a' and 12a" as well as exhaust valve 34, 34', 34" and supply valves 26, 26', 26" are interconnected electrically to a controller 16, 16', 16" which controls the operation of the system. The controller 16 can be a commercially available microcomputer such as the PIC16C76 variant manufactured by Microchip. A microcomputer as used herein includes all subsystems and peripheral components as is well known to those skilled in the art. The controller 16 has access to non-volatile memory which has been programmed to provide a predetermined comfort standard such as the algorithm described in U.S. Patent No. 5,283,735.

A microcomputer's non-volatile memory is programmed with data representing a desired massage type and level for the expandable chambers or air cells. By sequentially activating individual manifold valves, a pressure signal from the transducer can be generated for each cell. The pressure signals are received by the microcomputer and can be compared with the predetermined massage level data to generate a control signal that activates the pump or opens the supply valves and/or exhaust valves. By varying the number and location of the cells the system becomes responsive to the localized pressures exerted on the body for a great variety of uses. Additionally, in accordance with the present invention, expandable chambers forming the contouring elements of the seat back and seat bottom have their pressure controlled by massage indexes that will produce a desired concentrated massage action. Such data can be compiled and coded for use with individual expandable chambers or regions of expandable chambers. Where base occupant support is included as set-forth in United States Patent Application 08/808,511 commonly owned by the assignee of this application

and incorporated by reference, data sensed by transducer 18 is compared to the comfort standard and an actuation signal is generated which actuates the system to compensate for any differential between the programmed comfort level and the sensor generated data. In order to operate each cell or group of cells independently to provide an extensively adjustable system, the controller 16 is operative to actuate the supply valves 26, 26', 26" to isolate a selected expandable chamber or cell or group of expandable chambers or cells in communication with the manifold. The actuation is controlled in either an open or closed loop fashion to allow the pressure in the chambers 22, 22', 22" to equalize with the pressure in the expandable chamber or cells with which it is communicating. On an instantaneous basis there is a closed system among the connected expandable chambers, the feed tube 28, the common chamber 22, 22', 22" and the fluid supply thereby allowing the sensor to provide data from the closed system and to provide adjustment of the pressure in the isolated expandable chamber(s) by the MPU 21 to the desired comfort or pressure level. In operation, the controller 16 may open a valve 26, 26', 26" interconnecting a selected expandable chamber or cell or expandable chamber or group, such as the back seat region cells 10, with the common chamber 22, 22', 22" and allow the pressure in the selected system to settle out. The time to let pressure equalize is "pressure settling time". After the settling time, the pressure is sensed and a signal is sent to the controller 16 for comparison with the preprogrammed comfort data. The controller 16 then generates a signal relative to the difference in the comfort level sensed to the programmed comfort level and initiates a flow of fluid to or from the selected cell system to reduce the difference to zero. This sequence of operations is then repeated "n" times until each of the expandable chamber or systems are sensed and adjusted.

Alternatively, the controller 16, 16', 16" can be a controller system that will control the time in which fluid volume is transferred during inflate, deflate or equilibration as will be described in massage sequences that are based upon a predetermined massage index. Such timed control is an open loop control and does not depend upon the use of a transducer to sense pressure limits within the expandable chambers during a massage cycle.

The massage indexes of the present invention will be understood to have application to either the embodiment of Figure 2 or the embodiments shown in Figure 6 and in Figure 7 of previously mentioned USSN 8/808,511. The massage indexes also applies to the embodiments of Figures 4 and 5. It should be understood that the operation of the inflate, deflate and if desired equilibrate indexes to be described herein apply equally well to systems in which the expandable chambers or cells can be independently positioned or remain in a predetermined position on a support surface of a vehicle seat or the like without being part of a pressure system for supporting an occupant.

The device and method of this invention is characterized by using a preset inflate, deflate and if desired an equilibration massage index sequence as the programmed massage level and type and allowing the system to adjust the pressure in each expandable chamber to produce a predetermined massage where the level and intensity of a massage can be selected ranging from light to high that can correspond to a lower pressure or a lower frequency at the light setting; a medium pressure or a medium frequency at the medium setting, etc. In addition the operator can adjust the pressure level in accordance with his or her own perceived massage comfort. It is observed that by varying the comparative massage data and the number and location of the expandable chambers the system of this invention allows for a wide variety of massage types and an almost infinite flexibility of adjustment in a package that is simple, light weight, low cost and efficient.

Additionally, in accordance with the present invention, expandable chambers or cells forming the contouring elements of the seat back and bottom can also be located to form a support in a bed structure or other occupant support system. In this case as in the vehicle seat application the expandable chambers have their pressure controlled in response to the selected type of massage index resulting in a sequence of flow to and from each expandable chamber during a predetermined inflate, deflate and if desired equilibrate sequence.

As mentioned in the summary of the invention section of this application, in the present invention "inflate" is defined as an increase in volume or pressure of fluid (including but not limited to air) in one of one or more expandable

chambers 3a-3b; 4a-4c; 10a-10c. Such increase in volume or pressure is effected by opening supply valves 26, 26', 26" and closing exhaust valves 34, 34', 34" while energizing pump(s) 12, 12', 12" to move volumes of fluid either for a time or until a specified pressure is achieved. In most cases, the pump is connected to a manifold or common chamber 22,22', 22" and a supply valve 26, 26", 26" is connected to each of the expandable chambers to control the flow of fluid the between the common manifold chamber and the other one or more expandable chambers.

"Deflate" in the present invention is defined as decreasing the volume or pressure of fluid (a fluid may include air but is not limited to air as the fluid medium) in each one of the expandable chambers. Such deflation is effected, in configurations shown in Figures 4 and 5, by closing a supply valve 26', 26" to one of the chambers 3', 3", 4', 4" and 10', 10" and opening an exhaust or vent valve 34', 34" to such expandable chambers to move volumes of fluid either for a time or until a particular pressure is achieved. Such deflation is effected, in another configuration shown in Figure 1, by opening a vent valve 34 (controls the flow of fluid from the common chamber to the atmosphere) and the supply valve 26 to the particular chamber (controls the flow of fluid between the common chamber and the other chambers).

Equilibrate is defined in the present invention as an exchange of fluid (including but not limited to air) between two or more of one or more expandable chambers. Such exchange of fluid is effected by closing the vent valve(s) of two or more chambers and opening supply valves to the same two or more chambers for a specified time. The fluid will flow from the higher-pressure chamber(s) to the lower pressure chamber(s) resulting in an equalization of pressure in all of the participating chambers. The resultant pressure will be less than the initial higher pressures and more than the initial lower pressures unless the pressures were equal to start with.

Looking specifically at the occupant support system of Figure 1, a system of M air zones (spaced parallel and full width expandable chambers or cells individually formed as shown at 3 (cells 3a, 3b and 3c), (cells 4a, 4b, 4c) and

10(cells 10a, 10b and 10c), where M is greater than or equal to one, m corresponds to one air zone (3a). For a given massage sequence, each step in the sequence is defined by an index, n, where n ranges from 0 to N-1. N is the total number of steps in the sequence. An air zone, m, maybe associated with more than one index, n, and the adjustment sequence is not constrained by the physical zone order 0 through M-1. The massage sequence is repeated as many times as necessary to complete the timed massage interval.

Let inflation be defined by I (n), deflation by D (n) and equilibration by E (n_0, n_1, ... n_{J-1}) where J ranges from 2 to M. For equilibration, the valves to the zones corresponding to the indexes are opened creating a pneumatic circuit between the zones thus allowing the pressures to equalize within the zones.

There are an infinite number of massage sequences that may be defined by assigning zones to indexes then defining the adjustment order of the indexes. In the simplest case, each index corresponds to a single zone and is defined according to the physical zone orientation. In more complex cases, the zone order assignment to the indexes may be random and one zone may correspond to more than one index.

Inflation and deflation may be based on time or pressure. If based on time, inflation or deflation is performed for a set period of time. The intensity of the massage is controlled by scaling the adjustment time. If based on pressure, the inflation or deflation is performed until a preset target pressure is achieved. In this case, the intensity of the massage is controlled by scaling the target pressure. Equilibration generally is active for a specific time. The sensation of massage speed is controlled by equilibration time or the velocity of the volume of airflow.

Massage sequences that include Indexes 0 through N-1

Sequence 1	Sequence 2	Sequence 3	Sequence 4*	
I(N-1)	I(0)	I(N-2)	I(0)	
I(N-2)	D(0)	D(N-2)	E(0,1)	
...	I(1)	Sequence ... continued	D(0)	
I(0)	D(1)	I(0)	I(1)	
D(0)	I(2)	D(0)	E(1,0)	

D(1)	D(2)		D(1)	
D(2)	Sequence ... continued			
Sequence ... continued	I(N-1)			
D(N-1)	D(N-1)			

Sequence 5	Seq. 5 cont.
E(0,1)	D(N-2)
I(0)	E(N-2,N-1)
D(1)	I(N-2)
E(1,0)	D(N-1)
I(1)	E(N-3,N-2)
D(0)	I(N-3)
E(2,1)	D(N-2)
I(2)	...
D(1)	E(1,2)
...	I(1)
E(N-1,N-2)	D(2)
I(N-1)	

*Sequence 4 is shown for a two-zone system. In this case m = n.

Additional massage sequences can be constructed from the sequences shown. For example implementing Sequence 1 followed by Sequence 2 or Sequence 3 followed by Sequence 4 provide two more massage types.

Sequences 1 and 2 are operative to produce groupings of cell to cell pulse and Sequences 3 and 5 are operative to produce an individual cell to cell inflate or deflate wave wherein the massage movement includes a sequence of inflate and deflate between the respective cells so as to provide more concentrated massage while maintaining a wave type movement of the cells producing the massage action. Sequence 4 is operative to produce massage in a two-zone system.

More specifically, Figure 1, omitting the headrest, shows 13 air cells (3a, 3b, 3c, 4a, 4b, 4c, 10a, 10b, 10c, 5, 6, 7 and 8 which are arranged in 11 air zones 3a, 3b, 3c, 4a, 4b, 4c, 10a, 10b, 10c, 5 and 6 combined and 7 and 8 combined. A massage system may have as few as 1 zone and as many zones as the seat and air cell size dictate. To use general terminology, let m correspond to a specific zone

where m ranges from 0 to M-1 and M is the total number of zones. The relation between an air zone and an air cell is that a zone may contain more than one air cell.

For massage in accordance with this invention, any zones may be inflated, deflated and possibly equilibrated in any sequence. A single air zone may be adjusted more than once in any single sequence. There are an infinite number of massage sequences depending on the total number of zones, the number of zones massaged, inflation/deflation/equilibration order in which in/out flow to each zone occurs.

One way to cover the variations is to define the inflation/deflation/equilibration sequence using indexes. Each index is associated with (represents) a single zone but a zone may be associated with more than one index. Indexes, n, range from 0 to N-1, where N is the total number of indexes.

Example: Assume a three zone massage is desired. The zones chosen are 3a, 3b, 3c on Figure 1. Assume the massage sequence contains 4 indexes: 0,1,2,3. The association between the zones and the indexes is chosen to be:

Index	Zone
0	3a
1	3b
2	3a
3	3c

The massage sequence then chosen is Sequence 3, for example.

Step	Action by Index	Action by Zone	Word Description
1	I(0)	I(5)	Inflate zone 3a
2	D(0)	D(5)	Deflate zone 3a
3	I(1)	I(6)	Inflate zone 3b
4	D(1)	D(6)	Deflate zone 3b
5	I(2)	I(5)	Inflate zone 3a
6	D(2)	D(5)	Deflate zone 3a
7	I(3)	I(7)	Inflate zone 3c
8	D(3)	D(7)	Deflate zone 3c
	Repeat	Repeat	

Thus, within the context of systems having expandable chambers that are each inflated and deflated by index selections to produce concentrated massage, there are an infinite number of possible massage sequences. The different massages depend on the number of zones active for massage, the sequences of inflations, deflations and equilibrations and the times or pressure settings (duration) associated with the air movement functions.

The specific sequences provided in the descriptions below are only a small subset of the range of possibilities.

The sequences currently implemented are (by index):

"Pulse"	"Wave"	Massaging	3 Zone
I(0)	E(0,1)	D(0,1,2)	D(0,1,2)
I(1)	I(0)	I(0), D(1,2)	I(0), D(1,2)
I(2)	D(1)	I(1), D(0,2)	I(1), D(0,2)
I(5)	E(1,0)	I(2), D(0,1)	I(2), D(0,1)
I(6)	I(1)	I(1), D(0,2)	Repeat all except
I(7)	D(0)	I(0), D(1,2)	D(0,1,2)
D(7)	E(2,1)	Repeat all except	
D(6)	I(2)	D(0,1,2)	
D(5)	D(1)		
D(2)	E(5,2)		
D(1)	I(5)		
D(0)	D(2)		
Repeat	E(6,5)		
	I(6)		
	D(5)		
	E(7,6)		
	I(7)		
	D(6)		
	E(6,7)		
	I(5)		
	D(6)		
	E(2,5)		
	I(2)		
	D(5)		
	E(1,2)		
	I(1)		
	D(2)		
	Repeat		

In each of these cases the expandable chambers do not carry the reference numeral designations shown in the various embodiments but it is understood that the designations are for a support system having zones 0, 1, 2 (could correspond to 4a, 4b, 4c) and zones 5, 6 and 7 (could correspond to 3a, 3b, 3c).

What is claimed is:

1. A massage method for a seat or body support system having more than one expandable chambers and including a pressure system for each expandable chamber and an exhaust system for each expandable chamber and a controller for operating the pressure and exhausts system the method comprising:

selecting a massage control index for operating the pressure system and exhaust system to control the pressures in each of said expandable chambers; and

controlling the pressures in each of the expandable chambers by connecting each of the expandable chambers to said pressure system to produce an inflow of a fluid to each of the expandable chambers followed by operating the exhaust system to produce an outflow of fluid from each of the previously inflated expandable chambers to produce a massage sequence in which each of the expandable chambers are selectively inflated and deflated by fluid flow to and from each of the expandable chambers.

2. The method of claim 1 further characterized by providing the pressure system as a source of pressurized fluid; providing a supply valve for controlling fluid flow from the pressure source to each of the expandable chambers; and providing an exhaust valve for controlling the fluid flow from a previously inflated expandable chamber in a manner to produce individual chamber to chamber inflate followed by chamber to chamber deflate.

3. The method of claim 2 further characterized by providing the exhaust system as a common exhaust; connecting said more than one expandable chambers to said common exhaust and opening said common exhaust in accordance with the massage index.

4. The method of claim 2 further characterized by providing the pressure systems as a pressure pump; providing the exhaust system as an exhaust pump; connecting said pressure pump and said exhaust pump to said array of expandable chambers in accordance with the massage index.

5. The method of claim 1 further characterized by providing a user initiated switching means; and providing a range of desired massage indexes in accordance with user selected preferences; and selecting one of said desired massage indexes from said range to produce individual chamber to chamber inflate followed by chamber to chamber deflate.

6. The method of claim 1 further characterized by providing the more than one expandable chambers as expandable chambers in a back and seat support.

7. The method of claim 1 further characterized by operating the pressure system for each expandable chamber to equalize the pressure between predetermined ones of the expandable chamber as each of the predetermined ones of the expandable chambers are selectively inflated and deflated.

8. The method of claim 1 further characterized by providing a pressure sensor; providing multiple valves and a pump; providing a microcontroller programmed in response to a signal from said pressure sensor to operate the multiple valves and a pump to conduct an initial inflate of the more than one expandable chambers to a gross pressure level with all of the valves initially opening; said initial opening occurring prior to the cyclically connecting of each of the expandable chambers to the pressure source in accordance with the massage index.

9. The method of claim 1 further characterized by providing the more than one expandable chambers as a series of zones; said massage index including

first inflating each of said zones in a series fashion; said massage index thereafter including deflating each of said zones in a reverse series fashion.

10. The method of claim 1 further characterized by providing the more than one expandable chambers as a series of zones including a first zone, a second zone and a third zone; the massage index including equalizing the pressure in the first and second zones by fluid transfer therebetween; thereafter inflating only the first zone and deflating the second zone while the first zone remains inflated; thereafter equalizing the pressure in the first and second zones; thereafter inflating the second zone; thereafter deflating the first zone while the second zone remains inflated; equalizing the pressure in the second and third zones by fluid transfer therebetween; thereafter inflating only the third zone and deflating the second zone while the third zone remains inflated.

11. The method of claim 1 further characterized by providing the more than one air cells as first and second air cells (O, 1); providing a massage index that cyclically varies the pressure in the air cells by inflating the first air cell; equalizing pressure between the first and second air cells; deflating the first air cell; reinflating the first air cell; controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell; and deflating the first air cell.

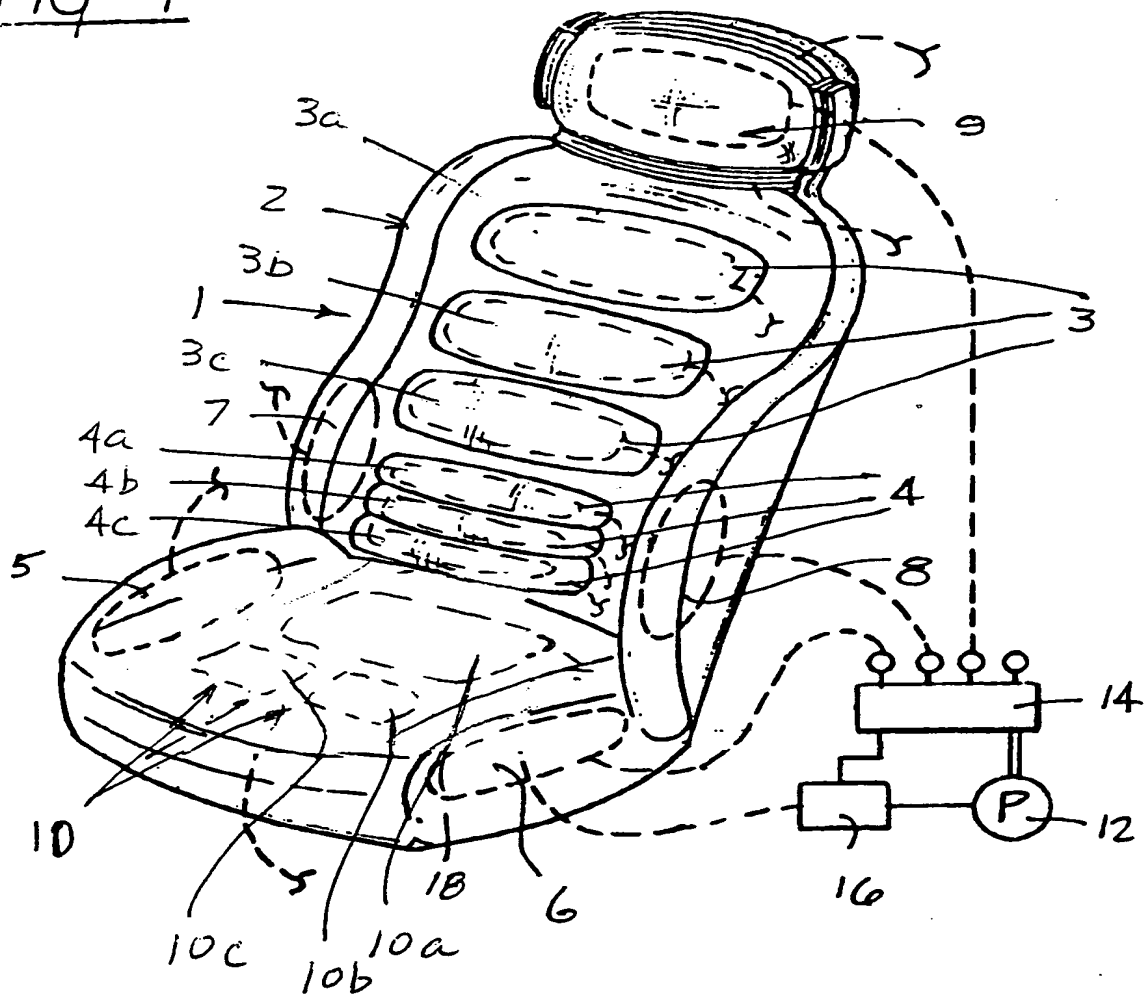
12. The method of claim 2 further characterized by providing the more than one air cells as first and second air cells (O, 1); providing a massage index that cyclically varies the pressure in the air cells by inflating the first air cell; equalizing pressure between the first and second air cells; deflating the first air cell; reinflating the first air cell; controlling the valved communication to equalize pressure between the first and second air cells following reinflation of the first air cell; and deflating the first air cell.

13. The method of claim 1 further characterized by providing the more than one expandable chambers as a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7; providing a massage index including equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the pressure in zone 6 and increasing the pressure in zone 7); inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

14. The method of claim 2 further characterized by providing the more than one expandable chambers as a series of zones including zone 0; zone 1; zone 2; zone 3; zone 4; zone 5; zone 6; zone 7; providing a massage index including equalizing the pressure in zones 0 and 1 by reducing the pressure in zone 1 and increasing the pressure in zone 0; inflate zone 0; deflate zone 1; equalize the pressure in zones 1 and 0 by fluid transfers from zone 0 to zone 1 reducing the

pressure in zone 0 and increasing the pressure in zone 1; inflate zone 1; deflate zone 0; equilibrate zones 2 and 1 (air transfers from zone 1 to zone 2 reducing the pressure in zone 1 and increasing the pressure in zone 2); inflate zone 2; deflate zone 1; equilibrate zones 5 and 2 (air transfers from zone 2 to zone 5 reducing the pressure in zone 2 and increasing the pressure in zone 5); inflate zone 5; deflate zone 2; equilibrate zones 6 and 5 (air transfers from zone 5 to zone 6 reducing the pressure in zone 5 and increasing the pressure in zone 6); inflate zone 6; deflate zone 5; equilibrate zones 7 and 6 (air transfers from zone 6 to zone 7 reducing the pressure in zone 6 and increasing the pressure in zone 7); inflate zone 7; deflate zone 6; equilibrate zones 6 and 7 (air transfers from zone 7 to zone 6 reducing the pressure in zone 7 and increasing the pressure in zone 6); inflate zone 6; deflate zone 7; equilibrate zones 5 and 6 (air transfers from zone 6 to zone 5 reducing the pressure in zone 6 and increasing the pressure in zone 5); inflate zone 5; deflate zone 6; equilibrate zones 2 and 5 (air transfers from zone 5 to zone 2 reducing the pressure in zone 5 and increasing the pressure in zone 2); inflate zone 2; deflate zone 5; equilibrate zones 1 and 2 (air transfers from zone 2 to zone 1 reducing the pressure in zone 2 and increasing the pressure in zone 1); inflate zone 1; deflate zone 2; repeat.

FIG - 1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3b
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3
3c
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4
4c
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10b
10a

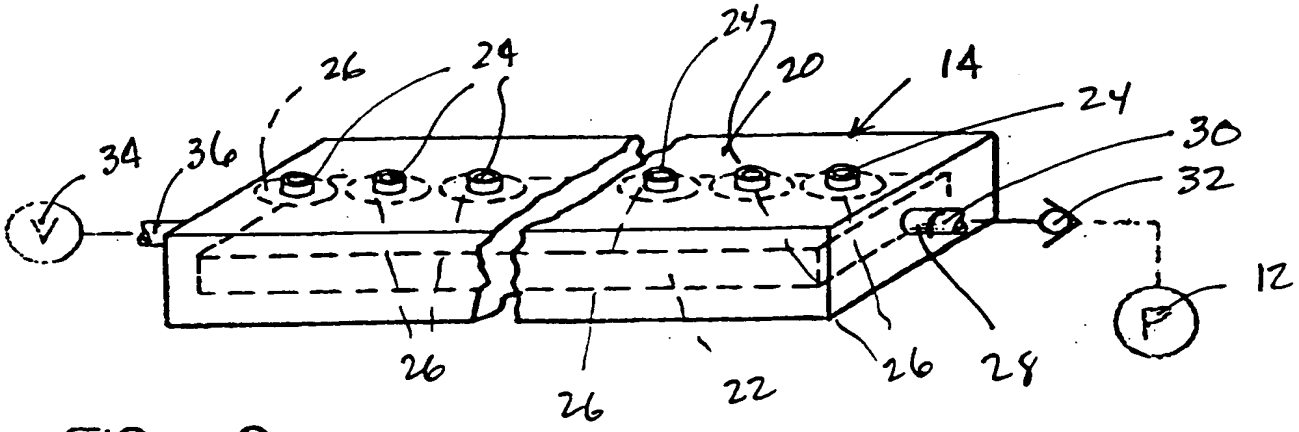
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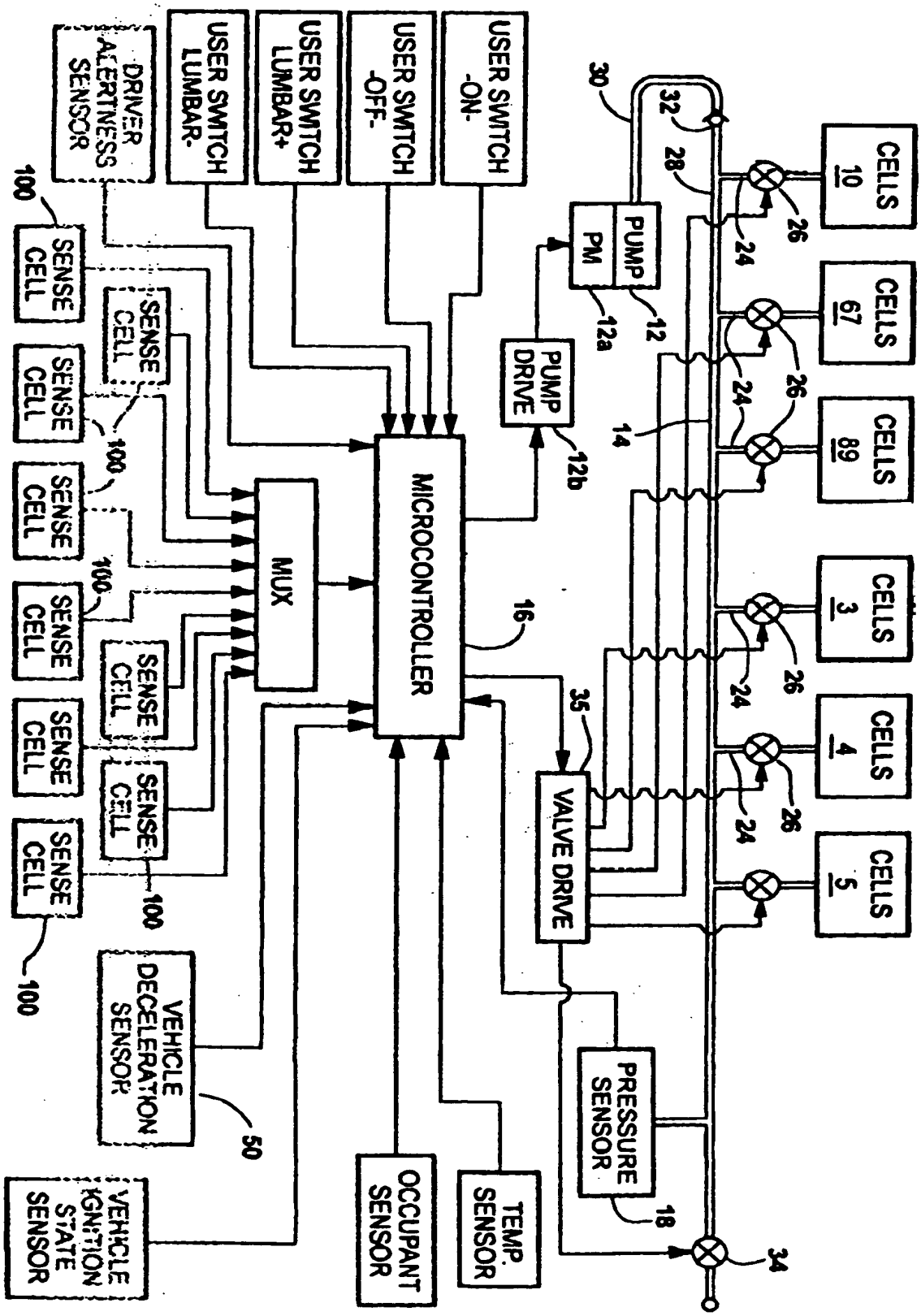
FIG - 2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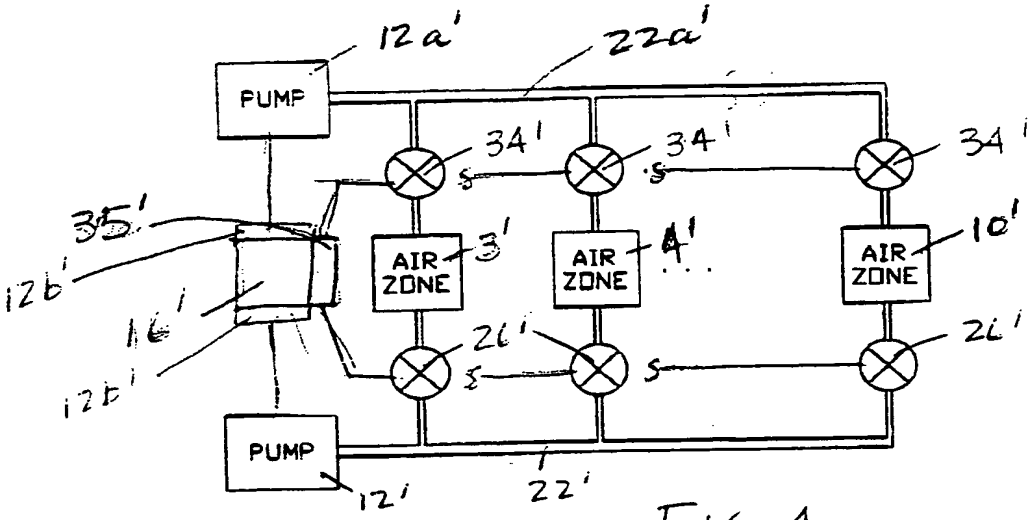
CELLS 67
CELLS 89
CELLS 3
CELLS 4
CELLS 5
PUMP PM
12
12a
PUMP DRIVE
12b
MICROCONTROLLER
16
MUX
VALVE DRIVE
35
PRESSURE SENSOR
18
TEMP. SENSOR
OCCUPANT SENSOR
VEHICLE DECELERATION SENSOR
50
VEHICLE IGNITION STATE SENSOR
DRIVER ALERTNESS SENSOR
USER SWITCH -ON-
USER SWITCH -OFF-
USER SWITCH LUMBAR+
USER SWITCH LUMBAR-
SENSE CELL
100
14
24
26
28
30
32
34

FIG - 3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PUMP
34'
34'
34'
35'
12b'
16'
12b'
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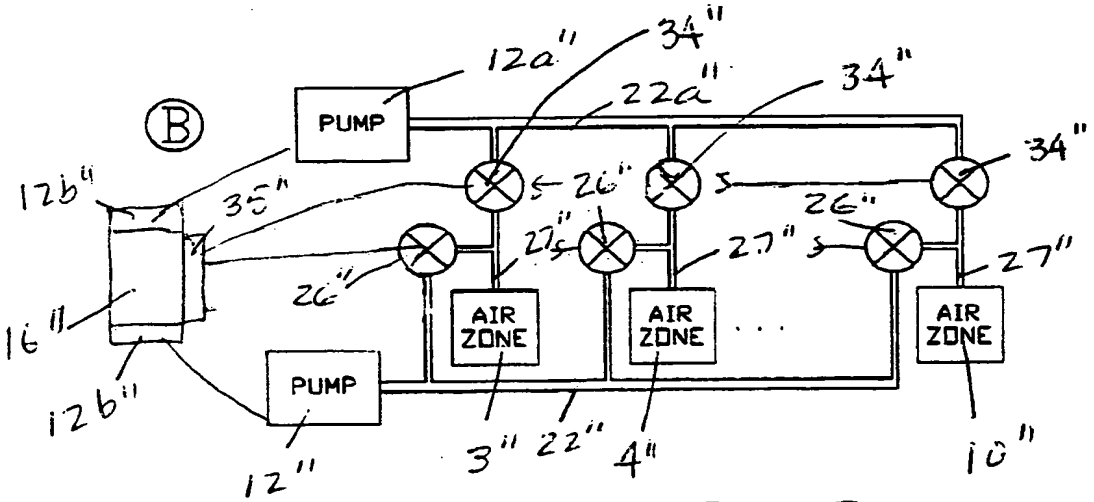
AIR ZONE 4'
AIR ZONE 10'
26'
26'
PUMP
12'
22'

FIG. 4


B
12a"
34"
22a"
34"
PUMP
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12b"
35"
26"
26"
27"
27"
27"
16"
AIR ZONE
AIR ZONE
AIR ZONE
12b"
PUMP
12"
3"
22"
4"
10"

FIG. 5

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(81) Designated States *(national)*: CA, CN, JP, MX, US.

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Published:
— *With international search report.*

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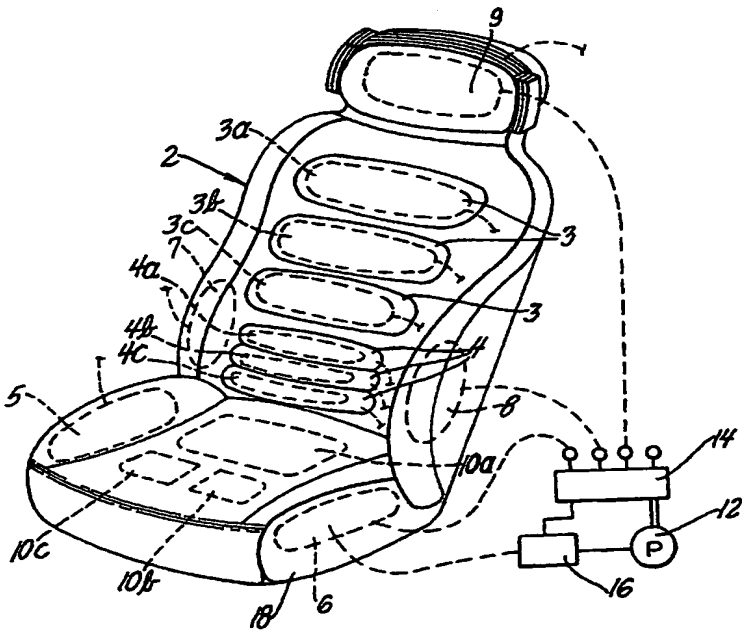
12 July 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTIPLE BLADDER PARTIAL BODY OR FULL BODY SUPPORT MASSAGE SYSTEM INCLUDING A METHOD OF CONTROL



(57) Abstract: A method for controlling a fluidly (in some cases pneumatically) controlled support surface (2) for an occupant system or bed having an array of expandable chambers (1) or cells, which include: providing such chambers, connecting the chambers to a source of pressurized fluid (air), and inflating the chambers to produce a massage movement that includes a sequence of inflation and deflation at each of the respective cells in accordance with a massage index for concentrating the massage action on an occupant.

WO 01/00132 A3

INTERNATIONAL SEARCH REPORT

Intern . .onal application No.
PCT/US00/17280

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A61H 7/00
US CL : 601/148-150, 152

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 601/148-150, 152

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,762,618 A (YAMANAKA et al.) 09 June 1998 (09.06.1998), see entire document.	1-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2000 (12.12.2000)	25 JAN 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Mickey Yu Telephone No. 703-308-0858

Form PCT/ISA/210 (second sheet) (July 1998)

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

279
EVANS, John, C.
Reising, Ethington, Barnes,
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Date of mailing (day/month/year)
06 April 2001 (06.04.01)

Applicant's or agent's file reference
FP-4039.002 MCW

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Applicant
MCCORD WINN TEXTRON INC. et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :CA,CN,JP,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   National :MX

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

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1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:
Henrik Nyberg

Telephone No. (41-22) 338.83.38